

Unusual statistics about rollover accidents of buses – VII.

1. This is the 7th statistics in the line. The previous ones may be found:
 - I. 78th GRSG meeting, April 2000, informal doc. No.6
 - II. 80th GRSG meeting, April 2001, informal doc. No.5
 - III. 83rd GRSG meeting, October 2002, informal doc. No.7
 - IV. 84th GRSG meeting, May 2003, informal doc. No.4
 - V. 85th GRSG meeting, October 2003, informal doc.No.1/Rev.1.
 - VI. 87th GRSG meeting, October 2004, GRSG-87-5
2. The unusual way of collecting accident statistics – using the reports, information of the media – has been described in the earlier documents listed above. In the Annex of this document 60 new rollover bus accidents have been collected in the last 11 months, which means that altogether there are 282 rollover bus accidents, from which some interesting tendencies, conclusions, information may be read out. Table I. gives a summary of the seven statistics, containing all the 282 accidents.

Table 1.

Summary of rollover statistics	Statistics I.- III. 1990- 2002	Statistics IV-VI 2003- 2004	Statistics VII 01.10.2004 31.08.2005	Σ (I-VII)
Number of accidents	97	125	60	282
Number of countries involved ⁽¹⁾	min.37	min.42	min.36	min.62
Total number of				
- fatalities	1011	1545	731	3287
- serious injuries	304	380	178	862
- light injuries	415	270	120	805
- injuries without classification	508	1192	384	2084
- reported “many injuries”	9 times	8 time	3 times	20 times
Type of rollover (severity)				
- turned on side	11	29	13	53
- rollover from the road ⁽²⁾	43	44	20	107
- serious rollover ⁽³⁾	18	42	13	73
- combined accident ⁽⁴⁾	25	20	14	59
Category of the bus rolled over				
- C I. (city, suburban)	6	1	0	7
- C II (intercity, local)	6	9	8	23
- C III (tourist, long-distance)	48	42	20	110
- Double decker	5	6	2	13
- Small bus ⁽⁷⁾	11	35	14	60
- School bus ⁽⁸⁾	3	3	2	8
- Other (worker, pilgrim, etc.)	5	2	1	8
- unknown	13	27	13	53
Deformation of superstructure				
- serious deformation ⁽⁵⁾	15	28	8	51
- slight deformation ⁽⁶⁾	21	31	13	65
- no information	61	66	39	166

Table I. needs some explanations which follow below (The reference numbers are used in Table I. as well):

- (1) countries may be involved as manufacturer, approval authority, operator or the scene of the accident.
- (2) not too severe accident, but more than turning on side (1/4 rotation): roll down into a ditch, down on a slope (not more than 2 rotation) turned down from an overbridge of a highway (the level difference between the start and end position less than 10 m)
- (3) more than two rotation, more than 10 m level difference in the rollover or falling down
- (4) the combined accident means: rollover after a serious frontal collision, rollover with fire, falling into water after rollover, etc.
- (5) serious deformation means the damage of the survival space, (the collapse of the superstructure obviously belongs to this category).
- (6) slight deformation means that the survival space very likely is not damaged in the rollover accident.
- (7) in the media reports this category is called: minibus, microbus, small bus, midi bus, club bus, ambulance bus, etc. without exact specification
- (8) in many cases children, students were transported by normal coaches, these accidents are counted as coach accidents.

3. Worldwide situation of the bus rollover accidents.

This new method collects worldwide statistics but this statistics is projected by the Hungarian media (It means that from the far countries only the very serious accidents are reported) Table 2. gives the yearly distribution of the collected accidents. It is interesting to mention that the real collection of the data started before 2002, but the observation in this period was contingent. The intensity of the collection was increased during the years. The small buses, mini buses were out of interest before 2002. So the yearly increasing number of bus rollovers does not cover a real tendency, but it shows the result of a more precise and intensive observation of the media (More newspapers, TV and radio channels are involved)

The number of the registered buses in Hungary is around 19 thousand. This fleet produces 12-15 rollover accidents per year. (Independently from the casualties) The complete European bus fleet could be in the range of 500-550 thousand units. Using the Hungarian proportion the expected number of bus rollover accidents in Europe could be in the range of 310-430/year. It is interesting to mention that in Spain 33 rollover accidents were reported [1] between 1984-88 and 20 in the years 1991-92 [2] These figures involve only the tourist coach accidents in which passengers died. (At least one)

Table 2.

	Before 2000	2000	2001	2002	2003	2004	2005*	Total
Hungary	6	4	13	12	14	20	11	80
Europe (excl. H.)	23	7	6	8	15	14	9	82
Other than Europe	11	7	12	19	28	29	14	120
Total	40	18	31	39	57	63	34	282

* only the first 7 months from the total year

The world wide statistics means that at least 62 countries are involved anyhow (see Table 1. and belonging remarks) The scene of the accident is known in every case (100%) but the manufacturer, operator and the approval authority (if any) in less cases, as Table 3. shows.

Table 3.

Known from the statistics (as country)	Number	%
Scene	282	100
Operator	209	74
Manufacturer	75	27
Approval authority	23	8

4. The severity of the rollover accident

It is an essential issue when determining the standard approval test, this expresses the demand of the public opinion: in which kind of accident situations should be the passengers protected, the survival possibility assured. The numbers of the different kind of rollover accidents – based on their virtual severity – are shown in Table 1. It seems to be acceptable to say that the first two accident types, the “turn on side” and, “rollover from the road” accident categories should be covered by the standard rollover test, by the approval. That means, in these kind of accidents the occupants should be protected. (“protected rollover accidents” PRA) In this statistics 160 accidents (57% of the total) belong to these two categories.

It must not be forgot that the rate of the severity in this statistics depends on the locality of the accident, or in other words: this rate is strongly deformed. E.g. a “turn on side” of a minibus without fatalities is reported by the Hungarian media only if it happened in Hungary, but it is not a news if it happened in Brasilia or China. This is proved by Table 4. The conclusion of this effect is that the more severe rollover accidents are over-represented in this accident statistics considering the whole world. Table 5. shows the decreasing ratio of PRA-s when widening the area of the observation. In Hungary the 92% of the rollover accidents belong to PRA (No big mountains, precipices, all rollover accidents are reported even if there was no fatality, no injury, etc.) Out of Europe the ratio of PRA-s is 28% (Mainly the serious and combined rollover accidents are reported as a catastrophe) It seems to be a reasonable estimation that 70-75% of the total bus rollover accidents around the world belong to PRA. Table 6. and Table 1. shows that 40% all of the casualties and 27% of the fatalities belong to PRA-s.

Table 4.

	Turned on side	Rollover from the road	Combined rollover	Serious rollover	Total
Hungary	36 (45%)	38 (47%)	6 (8%)	0	80 (100%)
Europe (excl. H.)	16 (19%)	36 (44%)	17 (21%)	13 (16%)	82 (100%)
Other than Europe	1 (1%)	33 (28%)	35 (29%)	51 (42%)	120 (100%)
Total	53	107	58	64	282

Table 5.

	All rollover accidents	Protected rollover accidents (PRA)	
		number	%
Hungary	80	74	92%
Europe (excl. H.)	82	52	63%
Other than Europe	120	34	28%
Total	282	160	57%

5. Control of the standard approval test used in ECE Regulation 66.

It is difficult to check, whether the recently used approval test is adequate to separate the strong superstructure from the weak one, to meet the demand of the public, to assure the required safety for the passengers at least in the PRA-s. A slow feedback can be found from this accident statistics, even if this statistics does not give direct information about the efficiency of the approval of buses regarding ECE-Reg.66. But indirectly an interesting comparison may be done. As it was defined above, PRA-s cover those accidents in which the passengers should be protected, the survival space shall be maintained. Among the 282 rollover accidents there are 116 in which we have information about the behaviour of the superstructure: 65 accidents did not cause damage in the survival space and in 51 accidents the survival space was harmed, including the total collapse, too. The casualties belonging to these groups are shown in Table 6.

The interesting comparison is shown in Table 7. in which the casualty rates (CR) of four kinds of rollover accident groups are compared. The fatality rate is 13 times, the serious injury rate 3,5 times higher when the survival space was damaged compared to the intact

survival space. From this recognition it comes the clear and practicable goal of the international regulation:

in the PRA-s the survival space shall be maintained.

It is interesting to mention on the basis of Table 7. that the number of the light injuries are not closely related to the type or category of the accident. It may be assumed that this type of injuries are caused mainly by the inside collision of the passengers when they are leaving their seats, seating position during the rollover process. The main tool to reduce this kind of injuries could be the use of seat belts. (It has to be emphasized that the seat belt can reduce the number of fatalities and serious injuries, too, and also the ejection of the passengers.)

Table 6.

Injury categories	"Protected rollover accidents"	Accidents in which the survival space	
		unharmed	damaged
Fatalities	895	63	658
Serious injuries	434	128	335
Light injuries	589	274	193
Injuries without classification	945	258	454
Reported "more injuries"	7 times	3 times	1 time
Number of accidents	160	66	51

Table 7.

Considered accidents	Number of events	Casualty per accident (CR)			
		Fatality	Serious injury	Light injury	Injury without classification
All rollover accidents	282	11,7	3,0	2,9	7,4
"Protected rollover accidents" (PRA)	160	5,6	2,7	3,7	5,9
Survival space unharmed	66	0,9	1,9	4,2	3,9
Survival space damaged	51	12,9	6,6	3,8	8,9

6. The high decker (HD) and double decker (DD) coaches

These vehicles became very popular in Category 3 (long distance and tourist coaches) in the last decade, their ratio in this category is increasing, mainly in the developed countries. Table 1. shows that 44% of the buses having rollover accident belong to Category 3. (123 accidents) including the double decker coaches (DD) too. The HD and DD coaches are really tourist and long distance coaches, independently from the fact that they are covered by two different general safety regulations (Reg.36. and Reg.107) Table 8. shows that 51 coaches were HD and DD among the rollover accidents (42% of the coaches) In 36 cases there was no information about the construction of the coach, so some of them might be as well HD or DD. It means that 45-48 % or more is an acceptable estimation for the representation of the high coaches (HD and DD) in the rollover accident of the long distance and tourist coaches. In other words: they are over-represented in the rollover statistics compared to their rate in the total population of long distance and tourist coaches around the world. Two important technical problems are connected to the high coaches:

- a) the dynamic lateral stability of these high vehicles is not sufficient, it should be increased and regulated,
- b) because of the geometrically limited structural deformation, caused by the given geometry of the approval rollover test (800 mm depth of the ditch) the existing approval test is not appropriate for HD coaches to separate the weak superstructure from the strong one [3] and for the DD coaches there is no regulation for the strength of the superstructure.

Table 8.

Construction of coaches having rollover accidents	Number	%
Traditional (total height 3-3,2 m)	25	20%
Probably traditional	11	9%
HD (total height more than 3,4 m)	38	31%
DD (double decker coaches)	13	11%
Non information about construction	36	29%
Total	123	100%

It is interesting to study the casualty rates (CR) of the high coaches (HD and DD together) Table 9. shows these figures.

Table 9.

Casualties in high coaches (51 accidents)	Number	Casualty rate (CR)
Fatality	392	7,7
Serious injury	292	5,7
Light injury	342	6,7
Injury without classification	362	7,1

Table 10. shows the distribution of the types of the rollover accidents among the high buses.

Table 10.

Type of rollover	Number	%
Turn on side	16	31
Rollover from the road	21	41
Serious rollover	4	8
Combined accident	10	20
Total	51	100

72% of the total belong to PRA. This figure fits well to the estimation given in para 4. These accidents happened mainly in Europe, including Hungary. The low figure of serious rollovers – compared to that one in Table 1. – is due to the fact that in the serious rollover accidents the majority of the bus types are unknown.

7. The rollover problem of small buses

This question has been neglected in the past. For the question “Why?” there are some possible explanations, e.g.:

- small bus, smaller passenger capacity, lower casualty figures in a rollover accident, lower public interest,
- no statistical data about the rollover accidents of small buses,
- the small buses (ECE-Reg.52) are not covered by ECE-Reg.66 requiring the strength of bus superstructure in case of rollover.

In this rollover statistics we started to collect the information about the small buses, too. Unfortunately not at the beginning. These accidents are collected only in the last 3 years. The first problem was – and still it is – that in the everyday language (in the news) different words are used: minibus, microbus, midibus, small bus, club bus, etc. without any technical background. ECE-Regulation No.52 has a clear specification: in a small bus the passenger capacity is between 9-22. But in the everyday practice the “small bus” covers rather different vehicles. Sometimes vehicles having 7-8 seats could be called also as micro buses, in spite of that officially they belong to category M1 (cars). As Table 1. shows: altogether 60 rollover accidents have been recorded. Table 11. gives the casualties in these accidents. It has to be mentioned that in two reports there was nothing about casualties, the accidents were mentioned in the radio as the reason of heavy traffic jam. The passenger capacity of the small buses (10-20 passengers) is roughly one forth compared to the big buses (40-80).

passengers). This multiplier 4 should be considered when evaluating the CR of the small buses.

Table 11.

Casualties in rollover of small buses (60 accidents)	Number	Casualty rate (CR)
Fatality	206	3,4
Serious injury	109	1,8
Light injury	98	1,6
Injury without specification	81	1,4
Report "some injuries"	once	-

Table 12. shows the distribution of the types of the rollover accidents among the small buses.

Table 12.

Type of rollover	Number	%
Turn on side	20	33
Rollover from the road	30	50
Serious rollover	2	3
Combined accident	8	14
Total	60	100

83% of the total belong to PRA. This figure fits well to the estimation given in para.4., while the majority of these small bus rollover accidents were reported from Hungary (see Table 13.) and as Table 5. shows, the PRA ratio in Hungary is high (92%)

Table 13.

Scene of rollover	Number	%
Hungary	44	74
Europe (excl. Hungary)	8	13
Other than Europe	8	13
Total	60	100

It is interesting to mention that frequent reason of the rollover of small buses is a side collision with a car or other vehicle. It happened 15 times among the 60 rollover accidents.

8. Occupant casualty risk (OCR)

The occupant casualty risk may be specified on many different ways, related to certain vehicle category, travelled way in km, certain accident type, position of the occupant in the vehicle, etc., or the combination of these. Accepting the goal that every bus occupant should have – theoretically – the same safety level in a PRA, independently from the category and construction of the bus, our limited definition for OCR could be: the risk of casualty (fatality, injury) of the individual bus occupant in one rollover accident. The OCR may be deduced from CR relating it to the individual occupant, or in other words, considering the passenger capacity of the bus (more exactly the number of passengers on board)

Table 14.

	Casualty rate (CR) / Occupant casualty risk (OCR)			
	Average in all accident (282 rollovers)	Average in PRA-s (160 rollovers)	Small buses (60 accidents)	HD and DD coaches (50 accidents)
Fatality	11,7/0,23	5,6/0,11	3,4/0,23	7,8/0,13
Serious injury	3,0/0,06	2,7/0,05	1,8/0,12	5,8/0,10
Light injury	2,9/0,06	3,7/0,07	1,6/0,11	6,8/0,11
Injury without classification	7,4/0,15	5,9/0,12	1,4/0,09	7,2/0,12
Total	25,0/0,50	17,9/0,36	8,2/0,55	27,6/0,46

Table 14. compares the CR/OCR values for different rollover situations (all rollover accidents, PRA-s) and for different bus categories (all bus categories, small buses, high buses) Trying to deduce the OCR values, the following assumptions were used:

- the average passenger capacity for all kind of buses is 50
- the average passenger capacity for high buses is 60
- the average passenger capacity for small buses is 15
- the buses were nominally loaded in the accident

Comparing the OCR values, the different distribution (ratio) of type of rollover should be also considered. To evaluate these CR/OCR values, only the orders and tendencies may be useful for us. But these orders and tendencies underline the necessity to do something for the protection of the passengers in rollover of the small and the high buses.

9. Some further interesting information

9.1. Ejection of occupants

The attention was called in the very beginning of the studies to the fact that the **ejection** could be very dangerous situation for the passengers in a rollover accident. This new type of accident statistics showed and analysed here is not detailed enough to get reliable information about this problem. But it has to be mentioned that there were 14 reports in which the ejection of at least 49 passengers were mentioned, most of them were killed (pressed) by the bus. There was one accident in Switzerland, where 14 passengers were ejected, but most of them survived. (seriously injured) These data prove that the ejection is an existing problem. There are different possibilities, tools to reduce the risk of the ejection, e.g. safety belt, laminated safety glazing of side windows, horizontal rail (hand strap) at the side windows (at the shoulder of the seating passengers) etc.

9.2. Fire in rollover accident

There were 8 rollover accidents in which the bus took fire and burned out completely. These are very severe accidents, listed among the “combined rollover”.

9.3. Hauling trailer by the bus

In the last two statistics an interesting phenomenon appeared: three coaches hauling trailer rolled over and it was supposed that the trailer contributed to the accident. One articulated coach also had a rollover accident: sudden, strong braking in a curve, the second part of the articulated coach could not follow the motion of the first one, the joint section was broken, the two parts were separated and the second part turned on its side.

9.4. Effect of the driving speed on the deformation mechanism

It is strongly discussed since the beginning of the study of bus rollover process that the driving speed of the bus could strongly influence the deformation mechanism of the superstructure. In 117 rollover accidents (among the 282 ones) there were acceptable information (photos, video reports) about the superstructures, about their deformations. There was no one, in which the effect of the driving speed (longitudinal components of the impact force) could be observed. Only the well known 4-5-6 plastic hinge mechanisms worked according to the lateral component of the impact force acting between the ground and the cantrail of the bus.

9.5. Effect of the circumstances on the rollover process.

There are different ways of the rollover, different reasons initiating the process. But the severity of the accident depends on the circumstances, the scene of the rollover (flat road, deep ditch, slope with considerable level difference, deep valley or precipice next to the road, etc.) [4] The stronger superstructure the more safety for the bus occupants in any circumstances.

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Bus rollover accidents collected between 01.09.2004 – 31.07.2005

	Date Scene of accident Country	Manufacturer Type of the bus Operator	Circumstances of the accident	Casualties on the bus	Deformation of the superstructure
6	1 04.07.1999 Narbonne France	HD tourist coach Czech operator	46 passengers on board. The bus collided a caravan in offset frontal collision and because of the hidden steering manoeuvre turned of its side.	1 fatality (driver) 6 serious injuries 6 light injuries	Certain deformations could be observed on the superstructure, but the survival space remained intact.
	2 31.07.2004 Léva Slovakia	Tourist coach DD Czech operator	62 passengers on board. Night driving, the driver very likely fell asleep, the bus left the road, hit and broke the side-rail and rolled into the ditch. Stopped on its side.	1 fatality 50 injuries	
	3 20.09.2004 South part of Kirgizistan	Local operator	26 students on board. Hilly road, the bus left the road, rolled down	19 fatalities 7 injuries	
	4 23.09.2004 South part of Brasilia	School bus Local operator	The bus drifted on the road, rolled down and fell into a water reservoir. 43 students on board, 8 (including the driver) survived	35 fatalities and lost	
	5 27.09.2004 Greece	HD tourist coach Local operator	37 students and 4 teachers on board. The bus collided a truck and rolled over, turned on its side on the road.	7 fatalities	The superstructure damaged, but did not collapse.
	6 9.10.2004 Brasilia	Local operator	Serpentine, hilly road. The bus left the road and rolled down into a deep precipice. 51 pilgrims on the board.	17 fatalities 18 injuries	
	7 10.10.2004 Arkansas USA	HD tourist coach Chicago operator	The bus drifted on the highway, rolled over and down on a slight slope. Probably 1,5 rotation, finally it stopped on its missing roof.	15 fatalities 16 injuries, many of them serious	The superstructure collapsed and disappeared
	8 11.10.2004 Brno Czech Republic	Small bus Polish operator	Two truck collided and the small bus was shoved on the road by them and rolled into the ditch	8 fatalities 8 serious injuries 7 light injuries	
	9 16.10.2004 Devecser Hungary	Tourist coach Hungarian operator	The bus hauled a trailer, transported the members of a sport club. On the serpentine, icy road the speed was relative high, the bus rolled down into the ditch, stopped on its side.	17 injuries	No significant deformation of the superstructure.
	10 14.10.2004 North part of Albania	Albanian operator	50 students on board, coming home from a holiday. A car hit the bus which was drifted on the hilly, narrow road and rolled down into a precipice.	15 fatalities 30 injuries	
	11 15.10.2004 Jammorti India	Local operator	Hilly road, the driver lost the control, the bus rolled down into a 100 m deep precipice. 6 passengers survived.	30 fatalities	

	12	28.10.2004 Close to Aman Jordania	Tourist coach	English tourist on board (The driver and crew Jordanian, also died) After puncture and blow out the coach rolled over and after that a van hit the bus.	12 fatalities 3 serious injuries 8 light injuries	
	13	8.11.2004 Close to Konya Turkey	Long distance coach Local operator	The two drivers relieved each other on the way when driving. They lost the control and the bus rolled over	1 fatality 6 serious injuries 25 light injuries	
	14	14.11.2004 Dunakömlöd Hungary	Mercedes Small bus Local operator	After a sudden manoeuvre of a truck its semi-trailer swung out from the track and hit a small bus on its driver compartment under an angle of 45°. The bus left the road and rolled into a ditch (1 m deep) The bushes, small trees stopped the further rotation, and the bus lied on its side.	2 fatalities 12 serious injuries	The DC seriously damaged, the survival space for passengers was harmed, but it did not collapse. Side windows were broken.
	15	21.11.2004 Salzburg Austria	SETRA HD tourist coach German operator	15 passengers on board. Driver lost the control on the snowy road, turned on its side, slipped away, rolled down on a slope having 6-8 m level difference. One passenger was ejected and pressed by the bus.	1 fatality 4 serious injuries 10 light injuries	The survival space remained intact, the side windows were broken.
10	16	23.11.2004 Ankara, Turkey	School-bus Local operator	On the snowy road the bus slipped, broke the rail-guard of a bridge and rolled down to the lower road	4 fatalities 42 injuries	
	17	28.11.2004 Lébény, M1 Hungary	Small bus Roman operator	The driver fell asleep, the bus rolled into the ditch (1-1,5 m deep) 7 persons on board. One person was ejected and killed by the bus.	3 fatalities 4 injuries	The superstructure was seriously damaged, the windows were broken
	18	13.12.2004 Brno, hw D1 Czech Republic	HD tourist coach Slovakian operator	19 persons on board. The bus driving up to the highway from the margin line, when a truck run into its left rear side. The bus turned on its side and slipped into the 2 m deep ditch. It stopped on its left side. More passengers were ejected and pressed by the bus. The two drivers did not injure.	6 fatalities 5 serious injuries	The left rear side (25% offset) was damaged, the superstructure slightly deformed, the survival space likely not damaged. Left side windows were broken.
	19	13.12.2004 Bakube Iraque	Small bus Local operator	The small bus hit a car, rolled over and got a fire. The passengers (the bus was overloaded) did not have the chance to evacuate	21 fatalities	
	20	18.12.2004 Érd, hw M1 Hungary	Microbus	Icy surface on the highway, the bus slipped and rolled into the ditch (1-1,5 m deep)	1 fatality 1 serious injury 1 light injury	
	21	20.12.2004 North part of Peru	Local operator	The driver lost the control, the bus – driving from Lima to Pucallpa – rolled over and fell into a river	49 fatalities 15 injuries	
	22	25.12.2004 East part of Pakistan	Intercity bus Local operator	High speed in a sharp curve, the bus drifted, the driver lost the control, rolled over into a water-worn.	17 fatalities 30 injury	
	23	30.12.2004 Torda Romania	Neoplan, 3 axles DD tourist coach Hungarian operator	72 persons on bard. The bus was hit by a car on DC side (the car driver died) the bus driver injured, the control systems (brake, steering) damaged, the bus run away, hit a brick fence, an electric installation, finally rolled into a 1,5 deep ditch, stopped on its left side.	16 serious injuries 8 light injuries	The front wall seriously damaged, the upper part of the superstructure slightly deformed, the survival space intact, side windows were broken.

	24	02.01.2005 North part of Spain	Tourist coach	The bus left the road and rolled over	5 fatalities 10 serious injuries 19 light injuries	
	25	09.01.2005 Békéscsaba Hungary	Small bus Hungarian operator	The bus was drifted, hit a pole and turned on its side. 4 persons on board.	3 light injuries	
	26	10.01.2005 Bidzsapur India	Local operator	In a sharp curve the driver lost the control, the bus rolled over and fell into a canal full with water. Nine persons (including the driver) survived.	57 fatalities	
	27	18.01.2005 Gödöllő, hw M3 Hungary	Mercedes Small bus Ukrainian operator	Dense fog, empty bus, hit the rail-guard of the highway, rolled over, $\frac{3}{4}$ rotation. The driver was ejected.	1 fatality (driver)	The superstructure collapsed, no survival space remained.
II	28	20.01.2005 Frankenberg Germany	Mercedes HD tourist coach Polish operator	The bus wanted to pass a truck, the driver lost the control, hit the rail-guard and turned on its side.	10 serious injuries 17 light injuries	No considerable deformation on the superstructure
	29	22.01.2005 Nepal	Local operator	Wedding guests on the board, the bus left the road, rolled down into a river.	32 fatalities 15 injuries	
	30	25.01.2005 Sükösd Hungary	Small bus Serbian operator	The driver lost the control in a curve, the bus drifted, rolled over into a ditch	15 serious injuries	The survival space was strongly damaged
	31	30.01.2005 North part of Columbia	Worker bus Local operator	Between Bogota and Medelin – probably because of technical fault – the bus left the road and rolled down from a bridge into the river Samana.	25 fatalities 6 injuries	
	32	13.02.2005 Szentgothard Hungary	Small bus Hungarian operator	The bus slipped on the icy road and rolled over	2 fatalities	
	33	13.02.2005 Tatabánya, hw M1 Hungary	Small bus Hungarian operator	Icy road, the driver lost the control and the bus rolled over.	1 fatality	
	34	13.02.2005 Mány Hungary	IKARUS 256 Local bus, 11 m VOLÁN	Icy road, the driver lost the control and the bus rolled on its side and slipped into a ditch	No injury	No damage of the superstructure
	35	13.02.2005 Bicske Hungary	IKARUS 260 Local bus, 11 m VOLÁN	Icy road, the bus turned on its side and slipped into a ditch	No injury	No considerable damage of the superstructure
	36	13.02.2005 Vértesacsa Hungary	IKARUS 256 Local bus, 11 m VOLÁN	Icy road, the bus turned into the ditch, laid on its side.	No injury	No considerable damage of the superstructure

	37	19.02.2005 Grünstadt, hw A6 Germany	HD tourist coach UK operator	Snowy road, 34 English tourists on board. The bus twirled and rolled over. One passenger was ejected, she died. The bus got fire and completely burned out. Passengers left the bus before the fire.	1 fatality 20 serious injuries	The superstructure strongly damaged
	38	04.03.2005 Emőd Hungary	IKARUS Intercity bus Local operator	School children on board. Icy road, the bus slipped into the ditch and turned on its door side. The children were evacuated through emergency windows.	3 light injuries	No significant deformation on the superstructure
	39	08.03.2005 Hszingche China, east	Tourist coach Local operator	44 persons, employees of an insurance company on board. The bus left the road rolled over, into a valley.	22 fatalities 22 injuries	
	40	11.2004 Hanover Germany	Vacanza 12 HD tourist coach Polish operator	The bus turned down from a highway into a 0,6 –0,8 m deep ditch and stopped on its right side. The passengers left the vehicle on the two escape hatches.	No fatality and serious injury	No considerable deformation, no one window was broken.
12	41	29.03.2005 Turkey	HD tourist coach	The coach drove on a sloping road with high speed. A car turned before the coach. The coach tried to avoid the collision, sudden steering maneuver, the driver lost the control, left the road on the other side, turned around, hit a building and turned on its left side. Radar recorded the whole process	No report about the casualties.	The superstructure did not have essential deformation.
	42	13.04.2005 Szecsuan region China	Long distance coach Local operator	The bus drifted down from the road and rolled into a 170 m deep precipice	24 fatalities	
	43	17.04.2005 hw M7 Hungary	microbus	The microbus was speeding; the driver lost the control, hit the side rail and rolled over. No report about casualties.		
	44	18.04.2005 China		The bus rolled down from a valley bridge on a hilly road.	27 fatalities	
	45	20.04.2005 Pomabamba Peru		Mountain road, heavy rain, the bus rolled down into a 500 m deep precipice.	27 fatalities 17 injuries	
	46	21.04.2005 Da Neng Vietnam	Local operator	30 veterans on the board, mountain road. The bus left the road and fell into a 70 m deep precipice.	31 fatalities	
	47	18.04.2005 Grand St Bernard Switzerland	Iliada, IRISBUS HD tourist coach (10,6 m) Swiss operator	The bus drove uphill on a mountain road, 25 passengers and 2 drivers on board. After a curve the bus broke the side rail on the other side, rolled down from the road, made 5-6 rotations on a slight slope and finally fell into a 100 m deep precipice. During the rotations 14 passenger were ejected.	12 fatalities 15 serious injuries	The superstructure completely collapsed in the first rolling stage where 14 persons were ejected.
	48	15.04.2005 Nagybecskerek	Intercity bus (12 m)	24 persons on board, 8 survived. A truck overtook a tractor on a bridge, its trailer hit frontally the bus, which brought through the guardrail of the	16 fatalities	The superstructure had no significant deformation, but the front wall had

	Serbia-Montenegro	Local operator	bridge and fell into the flooding river. Only 4 corpses were found.		serious damage.
49	08.05.2005 Pampa Peru		The bus drifted down from a bridge of a mountain road and rolled into a 300 m deep precipice. 60 passenger on board	40 fatalities 18 injuries	
50	16.08.2005 Gurnigelshassa-Switzerland	Small bus Local operator	The bus rolled over	3 fatalities 12 injuries	
51	01.05.2005 Flüelapass Switzerland	Tourist coach	A snow-slide whirled the bus down from the road and the bus rolled over	4 fatalities 16 injuries	
52	11.05.2005 Baguio Philippines	Intercity bus Local operator	On a hilly road going downwards the bus was accelerated because the brake refused to act, the driver lost the control, the bus drifted out, hit a rock and rolled over.	27 fatalities 20 injuries	
53	12.05.2005 Vranje Serbia-Montenegro	Tourist coach Macedonian operator	The bus broke through the side rail of a bridge and started to roll down into a precipice, but a tree blocked the rollover process.	1 fatalities 12 injuries	
54	23.05.2005 Kantstown Ireland	Tourist coach HD Local operator	40 schoolchildren on board. The bus hit a car, rolled over, turned on its door side, slipped down from the road to the sideway (No level difference) 5 children in the last seat-row died.	5 fatalities 6 critical injuries many injuries	Slight deformation of the superstructure, but the survival space probably was not harmed. Right side and rear windows were broken
55	22.06.2005 India	Local operator	The bus left the road and rolled down into a precipice	19 fatalities 20 injuries	
56	02.07.2005 Mallerdorf Germany	Small bus	The young driver (22) was speeding, lost the control, hit an electric switching box, run into a ditch, rolled over and its roof was crashed by a wall.	7 fatalities	
57	08.07.2005 Thimeon hw A54 Belgium	Articulated HD coach Belgian operator	Airport bus to the city center. Braking abruptly when taking an exit, the second part of the art. coach could not follow the first part, the joint section was broken, the two parts separated, second part turned on its side.	4 serious injuries 3 light injuries	No significant deformation on the superstructure.
58	10.07.2005 Majmene Eritrea	Local operator	The bus was overloaded (passenger capacity 45) It slipped on the road, rolled down into a 100 m deep precipice.	56 fatalities 30 serious injuries	The roof was completely crashed.
59	15.07.2005 Maclear South Africa	Intercity bus Local operator	The brake failed, the bus could not take a sharp curve and rolled down into a gully.	24 fatalities more injuries	
60	05.08.2005 Görbeháza hw M3 Hungary	Microbus Ukrainian operator	9 persons on board. The microbus drove from Italy to Ukraine. The bus left the highway on an exit, but could not take the curve, hit the side rail and rolled over, laid on its side in a small ditch. 3 persons were ejected.	3 fatalities 1 serious injury 3 injuries	The superstructure damaged, also the survival space, but did not collapse.

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